

APPLICATION FOR UNITED STATES LETTERS PATENT
FOR
METHOD AND APPARATUS FOR CONVEYING DESIGN INFORMATION OF
COMPUTER AIDED DESIGN (CAD) MODELS

Inventor(s): **Kenneth L. Davis**

Prepared by:
COLUMBIA IP LAW GROUP, LLC
4900 SW Meadows Road, Suite 109
Lake Oswego, Oregon 97035
(503) 534-2800

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METHOD AND APPARATUS FOR CONVEYING DESIGN INFORMATION OF
COMPUTER AIDED DESIGN (CAD) MODELS

FIELD OF INVENTION

5 The invention relates to the field of computer aided design (CAD). More specifically, the invention relates to conveying design information of a CAD model through multimedia associated with the CAD model.

BACKGROUND OF THE INVENTION

10 Computer aided design (CAD) programs have allowed users to design various parts in "virtual" space before the parts ever reach a manufacturer. As these CAD programs become more powerful, these parts in "virtual" space (i.e., CAD models) become more true to life. Complex CAD models, such as, for example, an entire automobile may be fully designed and assembled as multiple CAD models, down to the
15 smallest detail, such as a threads on a screw in the automobile.

 Because of the increasing complexity of the CAD models, conveying design information regarding various aspects of the CAD models have become increasingly important, especially since no longer are images of CAD models confined to workstations of engineering departments, but instead, images of CAD models may even
20 be displayed on handheld personal computers, such as, for example, Jornada pocket pc by Hewlett-Packard company of Palo Alto, California. This design information may include information, such as how a particular surface on a CAD model was constructed allowing subsequent users to modify or understand the CAD model, i.e., the design

intent of previous users. Other information may include information regarding how the CAD model is to be mated with other CAD models, i.e., assembled together. Conveying design information is important not only to other users, but also to manufacturers, marketing people, consumers, and engineers (to name but a few).

5 One solution to this problem is for the user to manually document the design information and history in a separate text document, such as by using a word processor or text editor. However, this solution does not allow the text document and the corresponding CAD model to be linked. In other words, there is not direct indication in the CAD model of which portions of the design information are further discussed in the
10 separate text document.

 Additionally, as forms of conveying information has advanced, digital audio and visual forms (commonly referred to as multimedia) have become increasingly utilized. For example, people commonly send audio video interleaved (.AVI) files through emails. However, ability of modern CAD programs to utilize multimedia for conveying CAD
15 model design information is virtually nonexistent.

 Thus, a need exists for an improved way of conveying CAD model design information. This and other advantages will be evident from the disclosure.

BRIEF DESCRIPTION OF DRAWINGS

The invention is illustrated by way of example and not by way of limitation in the figures of the accompanying drawings, in which the like references indicate similar elements and in which:

5 **Figure 1** illustrates a block diagram of one embodiment of a mechanical design application for conveying CAD model design information utilizing multimedia;

Figure 2 illustrates an example geometry piece of a mechanical design upon which an embodiment of the invention may be practiced;

10 **Figure 3** illustrates one embodiment of the invention for utilizing multimedia to convey CAD model information;

Figure 4 further illustrates conveying information regarding a CAD model utilizing different types of icons associated with the geometry piece, in accordance with one embodiment of the invention;

15 **Figures 5a, 5b and 5c** illustrate conveying CAD model information utilizing multimedia in accordance with an alternate embodiment of the invention;

Figure 6 illustrates the relevant operational flows of one embodiment of the multimedia information manager **108** of **Fig. 1**; and

Figure 7 illustrates one embodiment of a computer system suitable to be programmed with the mechanical design application of the invention.

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DETAILED DESCRIPTION OF THE INVENTION

In the following description, various aspects of the invention will be described.

However, it will be apparent to those skilled in the art that the invention may be practiced with only some or all aspects of the invention. For purposes of explanation, specific
5 numbers, materials and configurations are set forth in order to provide a thorough understanding of the invention. However, it will also be apparent to one skilled in the art that the invention may be practiced without the specific details. In other instances, well known features are omitted or simplified in order not to obscure the invention.

Parts of the description will be presented in terms of operations performed by a
10 computer system, using terms such as data, flags, bits, values, characters, strings, numbers and the like, consistent with the manner commonly employed by those skilled in the art to convey the substance of their work to others skilled in the art. As well understood by those skilled in the art, these quantities take the form of electrical, magnetic, or optical signals capable of being stored, transferred, combined, and
15 otherwise manipulated through mechanical and electrical components of the computer system, and the term computer system include general purpose as well as special purpose data processing machines, systems, and the like, that are standalone, adjunct or embedded.

Various operations will be described as multiple discrete steps in turn, in a
20 manner that is most helpful in understanding the invention, however, the order of description should not be construed as to imply that these operations are necessarily order dependent. In particular, these operations need not be performed in the order of presentation.

In various embodiments of the invention, computer aided design (CAD) model information is conveyed utilizing multimedia associated with one or more geometry pieces of the CAD model.

Figure 1 illustrates a block diagram of one embodiment of a mechanical design application for conveying CAD model design information utilizing multimedia. In **Fig. 1**, mechanical design application **100** includes an end user interface **102**, a design engine **104**, and a design database **106**. The design engine **104** includes, in particular, a multimedia information manager **108** in accordance with the invention. Together, the elements cooperate to conveying CAD model design information utilizing multimedia.

In **Fig. 1**, the end user interface **102** operates to graphically display and receive input, from a user, of CAD models under the control of the design engine **104**. Also under the control of the design engine **104**, the design database **106** operates to store CAD models and multimedia information of the CAD models. In particular, the multimedia information manager **108** automatically detects multimedia associated with the CAD models. Except for the teachings of the invention incorporated in the multimedia information manager **108**, the mechanical design application **100** is intended to represent a broad range of CAD drawing software known in the art, including but not limited to Autodesk Inventor™, available from Autodesk, Inc. of San Rafael, California.

Figure 2 illustrates an example geometry piece of a mechanical design upon which an embodiment of the invention may be practiced. As shown in **Fig. 2**, the geometry piece of the mechanical design is a three-dimensional CAD model **200**. Shown on the CAD model **200** are a number of features, such as for example, mounting holes **210**, guide dowels **215** and a center axial hole **220**. Additionally, the CAD model

200 may be part of a larger assembly (not shown) with the mounting holes 210 and the guide dowels 215 utilized to join the CAD model 200 to the assembly. In order for proper assembly of the CAD model 200 to the assembly, information regarding utilization of the mounting holes 210 and the guide dowels 215 are required to be conveyed. Additionally, design information regarding the CAD model 200 may also need to be conveyed, such as for example, how certain surfaces are designed and generated for possible modification of the CAD model 200. As will be described in further detail, these types of information regarding a CAD model may be conveyed utilizing multimedia, in accordance with one embodiment of the invention.

Figure 3 illustrates one embodiment of the invention for utilizing multimedia to convey CAD model information. In **Fig. 3**, a user (not shown) moves a cursor 310 in proximity to a geometry piece, in particular, the guide dowel 215. Shown in **Fig. 3**, as the cursor approaches the proximity of the guide dowel 215, the multimedia information manager 108 determines if multimedia is associated with the guide dowel 215 when the cursor is within a predetermined proximity. In **Fig. 3**, the multimedia information manager 108 determines if there is multimedia associated with the guide dowel 215, and if it is determined that multimedia is associated with the guide dowel 215, the guide dowel 215 is highlighted, in accordance with one embodiment of the invention.

Upon determining that there is multimedia associated with the geometry piece, the guide dowel 215, the multimedia manager 108 automatically generates and displays a leader line entity 315 and an icon 320. As shown in **Fig. 3**, the leader line entity 315 extends from the guide dowel 215 to the icon 320 displayed at the opposite end. The icon 320 is associated with the guide dowel 215 for accessing the multimedia

associated with the guide dowel **215**. Shown in one embodiment of **Fig. 3**, the displayed icon **320** associated with the guide dowel **215** is a graphical representation of a pencil and notepad signifying that this icon **320** includes a hyperlink to an application for text messaging, such as, but not limited to, Microsoft® Notepad (not shown), an electronic notebook (not shown) for maintaining design information as described in U.S. Patent Application serial no. 09/076,752, and pocket/handheld personal computers (Pocket/Handheld PC) versions.

In one embodiment shown in **Fig. 3**, since the icon **320** includes a hyperlink to an application to execute the multimedia, the application corresponding to the icon **320**, the user only needs to cursor click on the icon **320** to execute the application, i.e., to execute, for example, the electronic notebook. When the icon **320** is cursor clicked, the icon **320** may also include a pointer to a directory where the application may be located with information to be displayed by the application. Information displayed may include, for example, information regarding proper orientation of the guide dowel **215** for joining with the larger assembly. As a result, information regarding the CAD model is conveyed utilizing multimedia.

Figure 4 further illustrates conveying information regarding a CAD model utilizing different types of icons associated with the geometry piece, in accordance with one embodiment of the invention. In **Fig. 4**, the cursor **310** is detected in proximity to a mounting hole **210**. The multimedia information manager **108** determines that there is multimedia associated with the mounting hole **210**, and upon determining that there is multimedia associated with the mounting hole **210**, an icon **410** associated with the

mounting hole **210** and its leader line entity **415** is automatically generated and displayed.

Shown in the embodiment of **Fig. 4**, the displayed icon **410** associated with the mounting hole **210** is a graphical representation of a musical note and a speaker
5 signifying that this icon **410** includes a hyperlink to an application for sound recording, such as, but not limited to, Microsoft® Sound Recorder (not shown) and a Pocket/Handheld PC version.

In one embodiment shown in **Fig. 4**, since the icon **410** includes a hyperlink to an application to execute the multimedia, the application corresponding to the icon **410**, the
10 user only needs to cursor click on the icon **410** to execute the application, i.e., to execute, for example, the Sound Recorder. When the icon **410** is cursor clicked, the icon **410** may also include a pointer to a directory where the application may be located with information to be played by the application. Information played may include, for example, information regarding a last minute note to be aware of a dimensional
15 tolerance for the mounting hole **210**, when machining the mounting hole **210**.

Accordingly, in **Fig. 4**, an icon **420** and its leader line **425** associated with a surface **430** is also automatically generated and displayed with the icon **420** as a graphical representation of a piece of film signifying that this icon **420** includes a hyperlink to an application for video recording, such as, but not limited to, Windows Media Player by
20 Microsoft® (not shown) and a Pocket/Handheld PC version. The video may convey information for the operations involved in constructing the surface **430** of the CAD model **200**.

It should be appreciated by those skilled in the art that the location of the icon and the leader line may be edited by any method known in the art, such as, but not limited to, changing the icon location via cursor selection while the leader line entity follows the icon.

5 As a result, CAD model information is conveyed utilizing multimedia associated with one or more geometry pieces of the CAD model.

Except for the aspects of utilizing multimedia for conveying CAD model information of the invention, it should be appreciated by those skilled in the art that multimedia applications and hyperlinking to applications are known in the art, and
10 accordingly need not be discussed in further detail.

Figures 5a, 5b and 5c illustrate conveying CAD model information utilizing multimedia in accordance with an alternate embodiment of the invention. In **Fig. 5a**, when the cursor **310** is detected in proximity of the geometry piece **200**, for example, the guide dowel **510**, the multimedia information manager **108** determines that there is
15 no multimedia associated with the guide dowel **510**. Further, the multimedia information manager **108** determines if a request to associate multimedia with the guide dowel **510** is received. The request to associate multimedia may be received if the user (not shown) cursor selects the guide dowel **510**. As shown in **Fig. 5b**, if the request to associate multimedia is received, in order to facilitate association of multimedia with the
20 guide dowel **510**, a menu **520** is generated and displayed. It should be appreciated by those skilled in the art that the menu **520** might be any type of menu known in the art, such as, but not limited to, a "drop-down" Windows menu. In **Fig. 5b**, the menu **520** includes several types of multimedia **525-527** that may be associated with the geometry

piece, the guide dowel **510**, to convey CAD model **200** information, such as, but not limited to, an audio note **525**, a text note **526**, and an animation note **527**. Shown in **Fig. 5b**, for example, the user has selected to associate a multimedia in the form of an audio note **525** with the guide dowel **510**, and the multimedia information manager **108** receives this selection.

Shown in **Fig. 5c**, in response to receiving the request to associate multimedia with the guide dowel **510** and the selection of the type of multimedia through the facilitation of association of multimedia with the guide dowel **510**, the multimedia information manager **108** automatically generates an icon **530** and a leader line entity **535** with the icon **530** opposite the guide dowel **510**. Included in the icon **530** is a hyperlink to an application for sound recording, such as, but not limited to, Microsoft® Sound Recorder (not shown) and a Pocket/Handheld PC version. The user (not shown) may create a file for the application by recording the desired audio for the geometry piece, guide dowel **510**. Once the user completes the audio note, the multimedia information manager **108** associates the multimedia with the guide dowel **510**, and further, if the cursor **310** is no longer detected in proximity to the guide dowel **510**, the multimedia information manager **108** hides the leader line entity **535** and multimedia icon **530** associated with the guide dowel **510**.

Alternatively, in one embodiment, after receiving the selection of the type of multimedia and automatically generating the icon associated with the geometry piece, the multimedia information manager **108** displays the icon next to geometry piece without generating a leader line entity. A user may manually define a leader line entity from the geometry piece to the icon utilizing any known method in the art, such as, for

example, utilizing a pen-and-touch interface where the user "draws" the leader line entity. Once the leader line entity and the icon associated with the geometry piece are displayed, the multimedia information manager 108 combines the manually generated leader line entity with the icon for, as previously described, automatically generating the multimedia associated with the geometry piece.

As a result, CAD model information is conveyed utilizing multimedia associated with one or more geometry pieces of the CAD model with facilitation of a user in selecting the multimedia to be associated.

Figure 6 illustrates the relevant operational flows of one embodiment of the multimedia information manager 108 of **Fig. 1**. For the illustrated embodiment, multimedia information manager 108 is programmed in an event driven model, i.e., multimedia information manager 108 is designed to be executed in a system environment where various event notification services are available from the operating system. One example of such an operating system suitable for practicing the invention is the Windows®, Windows® CE, and Pocket PC operating systems, available from Microsoft Corporation of Redmond, Washington. In alternate embodiments, multimedia information manager 108 may be implemented in other programming approaches known in the art.

As shown in **Fig. 6**, responsive to an event notification informing multimedia information manager 108 of the fact that a cursor is within proximity of a geometry piece 610, multimedia information manager 108 determines if the cursor is held in position or is utilized to select the geometry piece 615.

If the cursor is held in position within the proximity of the geometry piece, the multimedia information manager **108** determines if the multimedia is associated with the geometry piece **620**. Upon determining that multimedia is associated with the geometry piece, multimedia information manager **108** causes an icon associated with the geometry piece to be automatically generated for accessing associated multimedia **625**. In one embodiment, if the cursor is within the proximity of more than one geometry piece with multimedia associated with it, the multimedia information manager **108** arbitrarily selects and automatically generates the icon associated with one of the geometry pieces until the cursor is moved closer to one of the other geometry pieces.

However, if the multimedia information manager **108** determines that multimedia is not associated with the geometry piece, the multimedia information manager **108** causes other functional blocks of design engine **104** to facilitate utilization of the CAD model by the user **640**.

If the cursor is utilized to select the geometry piece, the multimedia information manager **108** determines if a request to associate multimedia with the geometry piece is received **630**. If the request to associate multimedia with the geometry piece is received, the multimedia information manager **108** facilitates association of multimedia with the geometry piece **635**. As previously described, the request may be received in the form of a cursor selection of the geometry piece, and the facilitation may be in the form of a "drop down" menu displaying one or more types of selectable multimedia.

The multimedia information manager **108** receives a selection of the type of multimedia, when a user selects from the "drop down" menu **640**. Once the type of multimedia is received, the multimedia information manager **108** causes automatic

generation of an icon associated with the geometry piece for accessing the associated multimedia **625**.

However, if the request to associate multimedia with the geometry piece is not received, the multimedia information manager **108** causes other functional blocks of design engine **104** to facilitate utilization of the CAD model by the user **645**.

As a result, CAD model information is conveyed utilizing multimedia associated with one or more geometry pieces of the CAD model, including facilitation of selecting multimedia type.

Figure 7 illustrates one embodiment of a computer system suitable to be programmed with the mechanical design application of the invention. As shown, for the illustrated embodiment, computer **700** includes processor **702**, processor bus **706**, high performance I/O bus **710** and standard I/O bus **720**. Processor bus **706**, and high performance I/O bus **710** are bridged by host bridge **708**, whereas I/O buses **710** and **720** are bridged by I/O bus bridge **712**. Coupled to processor bus **706** is cache **704**. Coupled to high performance I/O bus **710** are system memory **714** and video memory **716**, against which video display **718** is coupled. Coupled to standard I/O bus **720** are disk drive **722**, keyboard and pointing device **724**, and communication interface **726**.

These elements perform their conventional functions known in the art. In particular, disk drive **722** and system memory **714** are used to store permanent and working copies of the mechanical design system incorporated with the teachings of the invention. The permanent copy may be pre-loaded into disk drive **722** in factory, loaded from distribution medium **732**, or down loaded from a remote distribution source (not shown). Distribution medium **732** may be a tape, a CD, and DVD or other storage

medium of the like. The constitutions of these elements are known. Any one of a number implementations of these elements known in the art may be used to form computer system 700.

In general, those skilled in the art will recognize that the invention is not limited
5 by the details described, instead, the invention can be practiced with modifications and alterations within the spirit and scope of the appended claims. The description is thus to be regarded as illustrative instead of restrictive on the invention.

Thus, an improved way for conveying CAD model design information utilizing multimedia has been described.

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